

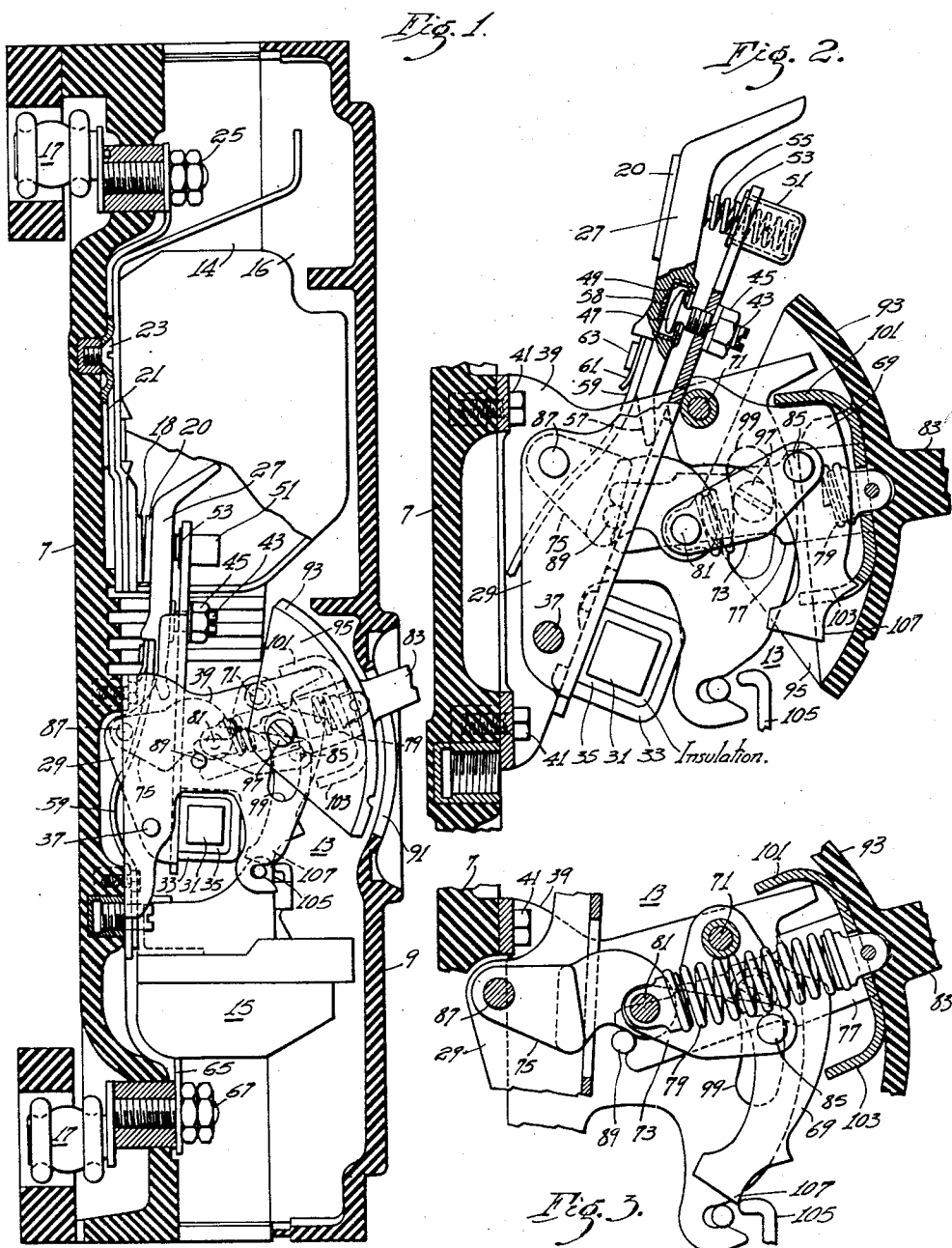
March 20, 1951

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2,546,016

CIRCUIT BREAKER

Original Filed Dec. 11, 1943



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2,546,016

CIRCUIT BREAKER

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Original application December 11, 1943, Serial No. 513,869. Divided and this application December 21, 1944, Serial No. 569,184

13 Claims. (Cl. 200—87)

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This invention relates to circuit interrupters, and more particularly to air circuit breakers of the trip-free type provided with a trip device automatically operable in response to predetermined overload conditions to trip the circuit breaker open irrespective of the position of the closing mechanism.

This application is a division of application Serial No. 513,869, filed December 11, 1943, now Patent No. 2,492,009, December 20, 1949, by Jerome Sandin and Ture Lindstrom, and assigned to the assignee of the instant invention.

An object of the invention is to provide a circuit breaker with an improved contact structure wherein the contacts are self-aligning.

Another object of the invention is to provide a circuit breaker having a plurality of fixed and movable contacts wherein each of the movable contacts is self-aligning with the corresponding fixed contact irrespective of the other contacts.

Another object of the invention is to provide a circuit breaker with improved contact mounting and adjusting means. A further feature lies in the fact that the adjusting means permits easy removal of the contact arm and the conductor connected thereto.

Another object of the invention is to provide a circuit breaker with an improved contact structure wherein novel means is provided for preventing the contacts from blowing open upon the passage of high current through the circuit of the breaker.

Another object of the invention is to provide an improved shock-proof circuit breaker which is simple, reliable in operation, and relatively inexpensive to manufacture.

The novel features that are considered characteristic of the invention are set forth in particular in the appended claims. The invention itself, however, both as to structure and operation, together with additional objects and advantages thereof, will be best understood from the following detailed description thereof when read in conjunction with the accompanying drawing, in which:

Figure 1 is a vertical longitudinal sectional view of a circuit breaker embodying the invention, the breaker being shown in the closed position.

Fig. 2 is an enlarged view, partly in section of the operating mechanism in the tripped open position.

Fig. 3 is a detailed view of a part of the operating mechanism showing the operating springs in the closed position resting against a

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fixed stop to act as a resilient stop for the handle.

Referring to Fig. 1 of the drawing, the three-pole circuit breaker comprises a base 7 of molded insulating material, a cover 9 also of insulating material secured to the base by means of bolts (not shown), operating mechanism indicated generally at 13, and a trip device indicated generally at 15. The casing formed by the base 7 and cover 9 is divided into three longitudinal compartments at the upper end thereof by partition walls 14, only one of which is shown, molded integral with the base, and matching partition walls 16 molded integral with the cover and cooperating with the partition walls 14. Each of the compartments is adapted to receive a stationary contact 18 and a cooperating movable contact 20 which, with their corresponding terminals and connecting conductors, collectively form the three poles of the breaker.

Each pole of the circuit breaker is provided with end terminals 17 disposed in suitable openings formed in the base at each end thereof.

The respective stationary contacts 18, one for each pole, are each mounted on the lower end of a conductor 21 secured, by means of a screw 23, to the base 7. At its upper end the conductor 21 is connected by means of a bolt 25 to the respective terminal 17.

The movable contact structures for the several poles are the same, for which reason only the one for the center pole will be described. The movable contact 20 for the center pole is secured to a contact arm 27 which is loosely supported on a channel-shaped switch-arm frame 29 (Fig. 2), only the one for the center pole being shown. The three channel-shaped frames are rigidly fastened for unitary movement by means of a metal tie bar 31 which extends across all of the poles of the breaker. The tie bar 31 is secured to the frames 29 adjacent the pivoted ends thereof by means of metal straps 33 which loop about the bar and have their ends projecting through openings in the frames and clinched there against. The tie bar 31 is encased in an insulating tube 35 in order to prevent short circuiting the poles of the breaker. The tie bar serves to mechanically interconnect all of the channel-shaped frames 29 so that all three of the frames are operated by a single actuating mechanism hereinafter described. The channel-shaped frame 29 of the center pole is pivotally supported on a pin 37 mounted in a U-shaped main frame 39 secured to the base 7 by means of screws 41. The pivot pin 37 forms the com-

mon pivot for the three mechanically connected switch arms or frames 29.

Each of the contact arms 27, to which the movable contacts 20 are secured, is attached to its corresponding channel-shaped frame 29 by means of a headed-adjusting bolt 43 threadedly engaging the channel member and locked in adjusted position by nuts 45. The head 47 of the bolt 43 loosely engages an inwardly extending flange on a sleeve 49 rigidly secured, by swedging or any suitable means, in a recess in the contact arms 27. A cup-shaped spring retainer 51 disposed in an opening near the upper end of the channel member 29 receives one end of a compression spring 53 having its other end engaging a spring guide 55 on the contact arm 27. The open end of the cup 51 is flanged outwardly to retain it in position on the channel member. The spring 53, in the open-contact position of the breaker, biases the contact arm 27 counterclockwise about the head 47 of the bolt 43, the movement being limited by a tail portion 57 of the contact arm engaging the channel member 29. In the closed position, the spring 53 provides the contact pressure.

A flexible conductor 59 is electrically and mechanically connected to the lower end of the contact arm by means of a clamp 61 of magnetic material and a rivet 63. The lower end of the flexible conductor 59 is connected to a conductor 65 which, in turn, is connected by means of a bolt 67 to the lower terminal 17 completing the circuit through the center pole of the breaker. The circuits for the two outer poles are the same as the circuit for the center pole, consequently, only the circuit for the center pole will be traced. This circuit extends from the upper terminal 17 through the bolt 25, conductor 21, stationary and movable contacts 18—20, contact arm 27, flexible conductor 59, conductor 65 and bolt 67 to the lower terminal 17.

The movable contact arm 27 is adjusted relative to the stationary contact by turning the adjusting bolt 43 so that in the fully closed position, the bottom edge of the contacts are in engagement and the upper or arcing portion of the contacts are slightly separated as shown in Fig. 1. In the closed position of the contacts, the head 47 of the adjusting bolt 43 is in engagement with a steel insert 58 in the bottom of the recess in the contact arm 27 which receives the head 47. When the channel-shaped member 29 rotates in clockwise or opening direction, as will be hereinafter described, the bolt 43 moves therewith permitting the spring 53 to rotate the contact arm 27 counterclockwise about the point of engagement of the contacts 18—20 bringing the arcing portions of the contacts into engagement. Continued opening movement of the channel-shaped member causes the lower or main contact portion of the contacts to separate, and finally, when the head 47 engages the flanged portion of the sleeve 49, causes the contacts to completely separate.

When the channel member 29 moves in counterclockwise or closing direction, the arcing upper portions of the contacts are the first to touch. Thereafter, as the closing movement continues, the head 47 engages the insert 58 and causes the contact arm 27 to rotate clockwise about the point of engagement of the insert with the head 47 of the bolt 43. During the latter part of this movement of the contact arm, the faces of the contacts are brought into parallel engagement and then the arcing upper portions of the con-

tacts separate. By use of the swivel mounting at the head 47, the contacts 59 may be easily removed and replaced if damaged by simply removing nut 45 and the screw at the lower end of the conductor.

By making the clamp member 61, which serves to clamp the flexible conductor 59 to the contact arm of magnetic material, the clamp serves also as an armature for preventing the contacts from blowing apart upon the occurrence of a sudden high current in the circuit of the breaker. The magnetic circuit comprises the clamp member 61 and the steel channel-shaped member 29 which supports the contact arm. The current passing through the flexible conductor 59 and the contact arm 27 provides sufficient energization of the magnetic circuit to hold the tail portion 57 in close to the channel-shaped member 29 and prevent the contact from being blown open.

The movable contact structure comprising the channel-shaped member 29, the tie bar 31 and the contact arm 27 for all three poles of the breaker, is adapted to be operated to open position and to closed position by the common actuating mechanism 13. This mechanism comprises a carrier or support member 69 pivotally mounted by means of a pin 71 on the main frame 39, a pair of toggle links 73 and 75 interconnecting the carrier 69 and the center-pole switch-arm frame 29, a U-shaped operating lever 77, overcenter springs 79 for connecting the operating lever 77 to the knee pivot pin 81 of the toggle links 73 and 75, and an insulating operating handle 83 for the operating lever.

The toggle links 73 are pivotally connected by means of a pin 85 to the carrier 69, while the toggle links 75 are pivotally connected by means of a pin 87 to the channel-shaped frame 29 for the center pole of the breaker. The two legs of the operating lever 77 are disposed adjacent the inner sides of the main frame members and are pivotally supported on pins 89 projecting inwardly from said frame members. The operating handle 83 projects through a slot 91 in the cover 9 and has an arcuate protective portion 93 and side plates 95 integral with the portion 93. The side plates 95 of the handle straddle the main frame 39 and are secured to the two legs of the operating lever 77 by means of screws 97 which extend through slots 99 in the adjacent frame members and threadedly engage the respective legs of the operating lever. The connecting portion of the operating lever is provided with formed-over portions 101 and 103. The portion 101 is for the purpose of engaging and resetting the carrier 69 to its latched position by movement of the operating handle as far as it will go in opening direction, in order to reset the mechanism following a tripping operation of the breaker. The carrier 69 is normally held in latched position as shown in Figure 1 by a latch 105 of the trip device 15, which engages the latch portion 107 of the carrier.

The operation of the circuit breaker operating mechanism is as follows: With the parts in the position shown in Fig. 1, in which position all of the contact means are closed and the carrier 69 is held in latched position; if the operating handle 83 is moved from the position shown in a clockwise direction to the opposite end of the slot 91 to rotate the operating lever 77 in a clockwise direction, the overcenter springs 79 will snap overcenter below the center line 81—85 and cause the toggle links 73—75 to collapse thereby causing simultaneous movement of all

of the channel-shaped frames 29 and the movable contacts 20 to the open-circuit position with a snap action. The mechanism is made more shock proof by arranging the pivot points so that the handle must be moved almost to the "off" position before the spring is snapped overcenter. To reclose the breaker, the operating handle is moved in the opposite direction back to the position shown in Fig. 1. This movement of the handle will cause the overcenter springs to snap over in the opposite direction and move the toggle to the in-toggle position to simultaneously close all of the contact means with a snap action.

The circuit breaker is opened automatically in response to overload currents occurring in the circuit of any pole of the breaker, by operation of the trip device 15. The trip device may be of any suitable type, preferably of the type disclosed and claimed in the copending application, Serial No. 513,868, filed December 11, 1943, now Patent No. 2,534,906, December 19, 1950, by G. G. Grissinger, J. Sandin and Ture Lindstrom, and assigned to the assignee of the instant invention. Such trip devices are provided with thermally-responsive means operable to release the latch 105 after a time delay in response to overload currents below a predetermined value and are also provided with electro-responsive means operable to instantaneously release the latch in response to overload currents above a predetermined value, or in response to short circuits.

When the latch 105 is released by the trip device in response to an overload current, it frees the carrier 69 and permits the springs 79 to rotate the carrier in a counterclockwise direction about its pivot 71, thus causing collapse of the toggle links 73-75 and movement of the channel-shaped member 29 and the movable contacts to the open-circuit position shown in Fig. 2. The breaker cannot be reclosed until the operating handle has been moved to full open position in order to reset and relatch the carrier 69 with latch 105. After the carrier has been relatched, the operating handle may then be moved to its closed-circuit position to effect closing of the contacts.

The invention provides a novel contact structure wherein the contacts are prevented from blowing open by the forces generated by the passage of high currents through the breaker, and in which the contacts are self-aligning.

Having described a preferred embodiment of the invention in accordance with the patent statutes, it is to be understood that various changes and modifications may be made therein without departing from some of the essential features of the invention. It is, therefore, desired that the language of the appended claims be given as reasonably broad interpretation as the prior art permits.

We claim as our invention:

1. In a circuit breaker, stationary contact means, a switch member, movable contact means mounted on said switch member, said switch member being movable to open and closed positions to open and close said contact means, operating mechanism for said switch member comprising an operating lever operable to cause movement of said switch member to open and closed positions, means for attaching said movable contact means comprising a single member mounted on said switch member and engaging a recess in the movable contact means to permit automatic alignment of said movable contact

means with said stationary contact means upon movement of said switch member to closed position, said attaching means being movable to vary the position of the movable contact means relative to the stationary contact means in the closed position of said switch member and means disposed in said recess for retaining said movable contact means on said switch member.

2. In a circuit breaker, stationary contact means, a switch member, movable contact means mounted on said switch member for universal movement relative to said switch member to permit automatic alignment of the movable contact means with the stationary contact means upon closure of said contact means, operating means for moving said switch member to open and closed positions to open and close said contact means, a single member for attaching said movable contact means comprising a member mounted on the switch member and having a lost motion connection with said movable contact means to permit automatic alignment of said contact means whenever said contact means engage, said member being movable to adjustably determine the position of the movable contact means relative to the stationary contact means, and spring means spaced from said attaching means for supporting one end of said movable contact means and for providing contact pressure in the closed position of the switch member.

3. In a circuit breaker, stationary contact means, a movable switch member, a floating contact member, said switch member being movable to open and closed positions to open and close said contact means, a single support member for attaching said floating contact member to said switch member, said member having a lost motion connection with said floating contact member to permit automatic alignment of the floating contact member with the stationary contact member whenever said switch member is moved to the closed position, said support member being adjustable to vary the position of the floating contact member relative to the stationary contact means, and spring means for supporting one end of said floating contact member and disposed to provide contact pressure in the closed position of the switch member.

4. In a circuit breaker, stationary contact means, a switch member, movable contact means mounted on said switch member, operating means for moving said switch member to open and closed position for opening and closing said contact means, supporting means for said movable contact means comprising a member mounted on said switch member and adjustable relative thereto, said supporting member having a head disposed in a recess in said movable contact means, and retaining means on said movable contact means engaging said head to retain said movable contact on said switch member and to provide universal movement of said movable contact means relative to said switch member to thereby permit automatic alignment of the contact means whenever the switch member moves to closed position.

5. In a circuit breaker, stationary contact means, a switch member, movable contact means mounted on said switch member, operating means for moving said switch member to open and closed positions to open and close said contact means, support means for said movable contact means comprising a member threadedly mounted in said switch member provided with a head disposed in an opening in said movable

contact means, and a flanged retaining member on said movable contact means engaging the head in a manner to permit universal movement of said movable contact means relative to said switch member to thereby permit automatic alignment of said contact means whenever said switch member moves to closed position, said threaded member being rotatable to vary the position of the movable contact means relative to the stationary contact means in the closed position of said switch member.

6. A circuit breaker comprising stationary contact means, a movable switch member, movable contact means mounted on said switch member, operating means for moving said switch member to open and closed positions to open and close said contact means, means for attaching said movable contact means to said switch member comprising a member on the movable switch member having a lost motion connection with said movable contact means to permit universal movement of said movable contact means relative to said switch member, said member comprising the sole means for attaching said movable contact means to said switch member, and biasing means independent of said attaching member and disposed to provide contact pressure in the closed position of said switch.

7. A circuit breaker comprising stationary contact means, a movable switch member of magnetic material, a pivoted contact carrying member, pivot means pivotally mounting said contact carrying member at a point intermediate the ends thereof on said switch member, a movable contact mounted on said contact carrying member, means for actuating said switch member to open and closed positions to open and close said contact means, spring means disposed on one side of said pivot means providing contact pressure in the closed position of said switch member, a member of magnetic material mounted on said contact carrying member on the other side of said pivot means, said magnetic member cooperative with said movable switch member in response to excessive currents flowing through said contact carrying member to increase the contact pressure.

8. A circuit breaker comprising stationary contact means, a pivoted switch member of magnetic material, pivoted contact means pivotally mounted intermediate the end portions thereof on said switch member for movement therewith and relative thereto, actuating means for moving said switch member to open and closed positions, spring means disposed adjacent one end of said movable contact means for providing contact pressure when said switch member is in the closed position, an armature secured to said movable contact means adjacent the other end thereof cooperative with said movable switch member in response to excessive currents to increase said contact pressure.

9. A circuit breaker comprising stationary contact means, a switch member, movable contact means mounted on said switch member, operating means for moving said switch member to open and closed positions for opening and closing said contact means, supporting means for said movable contact means comprising a member mounted on said switch member and adjustable relative thereto, said supporting member having a head disposed in a recess in said movable contact means, retaining means on said movable contact means engaging said head to retain said movable contact means on said

switch member and to provide universal movement of said movable contact means relative to said switch member, spring means disposed adjacent one end of said movable contact means for normally providing contact pressure in the closed position of said switch member, and a member of magnetizable material mounted on said movable contact means adjacent the other end thereof cooperating with said movable switch member in response to excessive currents to increase the contact pressure in proportion to the magnitude of the excessive current.

10. A circuit breaker comprising stationary contact means, a pivoted switch member of magnetizable material, movable contact means mounted on said switch member, operating means for moving said switch member to open and closed position to open and close said contact means, supporting means for said movable contact means comprising a member mounted on said switch member and having a head disposed in a recess in said movable contact means, retaining means on said movable contact means engaging said head to retain said movable contact means on said switch member, said supporting means and said retaining means being constructed and arranged to provide universal movement of said movable contact means relative to said switch member, spring means disposed on one side of said supporting means for normally providing contact pressure in the closed position of said switch member, and an armature mounted on said movable contact means on the other side of said supporting means cooperating with said magnetic switch member in response to excessive currents flowing through said contact means in proportion to said excessive current.

11. In a circuit breaker, a stationary contact, a switch member, a movable contact member mounted on said switch member, operating means for moving said switch and movable contact member to open and closed positions, a support element mounted on one of said members and adjustable relative thereto, said support element having a head disposed in a recess in the other of said members, and retaining means on the other of said members engaging said head to retain said movable contact member on said switch member and to provide universal movement of said movable contact member relative to said switch member to thereby permit automatic alignment of said contact means whenever said switch member moves to closed position.

12. In a circuit breaker, a stationary contact, a switch member, a movable contact member mounted intermediate its ends on said switch member, operating means for moving said switch member and movable contact member to open and closed positions, a support element mounted on one of said members and adjustable relative thereto, said support element having a head disposed in a recess in the other of said members, retaining means on the other of said members engaging said head to retain said movable contact member on said switch member and to provide universal movement of said movable contact member relative to said switch member to thereby permit automatic alignment of said contact means whenever said switch member moves to the closed position, and spring means disposed on one side of said support element to provide contact pressure in the closed position of said switch member.

13. In a circuit breaker, a stationary contact,

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a switch member, a movable contact member mounted intermediate its ends on said switch member, operating means for moving said switch member and said movable contact member to open and closed positions, a support element mounted on one of said members and adjustable relative thereto, said support element having a head disposed in a recess in the other of said members, retaining means on the other of said members engaging said head to retain said movable contact member on said switch member and to provide universal movement of said movable contact member relative to said switch member to thereby permit automatic alignment of said contact means whenever said switch member moves to the closed position, spring means disposed on one side of said support element to provide contact pressure in the closed position of said switch member, and a member of magnetic material secured to said movable contact member on the other side of said support element cooperating with said switch member to increase the contact pressure in response to excessive currents.

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